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THE SOLAR SURFACE DURING THE PAST FIVE YEARS—A REVIEW OF SUNSPOT OBSERVATIONS MADE AT ALTA, IOWA, FROM 1921 TO 1925

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Observations of the solar surface were commenced by the writer in August, 1890, and brief reviews have been published in these Proceedings from time to time, the first being in Volume X, 1902, and succeeding ones in Volume XV, 1908, and Volume XXVIII, 1921, the present paper brings the series down to the close of the year 1925, covering a period of over 35 years and embracing four minimum and three maximum epochs of the 11½ year cycles of solar changes. All of the five years' observations were made with a 5½-inch refracting telescope, equatorially mounted, being the same instrument which has been in use since September, 1907.

The daily observations consist of noting the number of groups of spots, each outbreak of one or more being considered as a group, next the number of individual spots in each group are counted and lastly the number of areas of faculae. The field of view in a low power eyepiece of a Herschelian diagonal is supplied with a squared reticule and the approximate heliographic positions of the disturbances noted and sketched on similarly squared paper, by this means the identity of the groups is determined and the life histories of all secured; when more accurate positions are desired a position micrometer is used in connection with the usual tables for physical observations of the sun taken from the American Ephemeris.

At the close of the year 1920 included in my last communication to the Academy, the sun's surface was only gradually returning to a more quiescent condition, the period being about midway between the maximum of 1917 and ensuing minimum.

1921

The principal disturbance of this year was the giant group of May 7 to 20, following a comparatively quiescent period. A wonderful group of the two-spot variety was the seat of great

activity especially on the 11th and 12th, culminating on the 14th and 15th, when the group was near the center of the visible disc. Aurorae and magnetic effects beginning in the afternoon of 14th continued until after midnight of 15th; widespread disturbances of the telegraph, telephone and cable lines were noted in America and Europe; locally telephone operators experienced some difficulty in keeping drop numbers in place on the switchboard. The spectroscope disclosed brilliant flames and reversals in the H_a line in the afternoon of the 15th which at 4:30 P.M. had almost subsided; the aurora visible in the late evening of the 15th was very beautiful. This disturbed condition of the sun was followed by a marked period of quiescence, some spotless days being noted each month from August to December.

1922

On thirty-nine percent of the observing days the sun was spotless this year, and every month except March showed an increasing number of such days and a smaller number of spot groups. A large group was in north latitude March 1 and on the central meridian which was spectroscopically active with associated aurora visible in the evening. On the 3rd the groups were all larger and very fine, covering a large area of the disc, but on the 8th another fairly large group which had appeared by solar rotation and was about three days from the eastern limb in north latitude, was the location of very brilliant H_a reversals, and with the slit widely opened the outline of a wonderfully intricate prominence was seen overlying the group. It was intensely brilliant in the hydrogen lines and could be seen through deepening haze and light clouds for some time.

A period of decreasing activity set in after the disappearance of these early March groups, with spotless days during the month of April, and with the exception of smaller but active groups in early May, the disc was mostly clear until the latter part of July. August and September were quiet, but in October from 18th to 21st an active group developed on the disc about in 5 degrees south latitude and passed the west limb by rotation spectroscopically much disturbed on the 21st, this spot group returned in early November and again during the closing days of the same month. The year closed with a large group making the transit of the disc.

1923

Spotless days increased to forty-eight percent of the observing

days this year. No group of the first magnitude was observed and the occasional moderate sized ones which were visible in June, September, October and November were rather short-lived. Quiescent periods were noted in February, April, August and first half of December.

On July 30th a group ushering in the new cycle of sunspot activity was noted just within the limb at about 28 degrees south latitude, it was shortlived and on August 1st was invisible, but a spot was again noted in this region September 2nd, when it was a little east of the central meridian, it finished the transit of the disc on September 9th. A third transit occurred from September 23rd to October 5th; a fourth returned October 21st, after which it gradually faded out.

1924

The sun was observed on 68 days during the first four months of this year, 75 percent of them being spotless. The year opened with a period of long quiescence which beginning December 28, 1923 lasted until February 13, 1924 and brought to a close the minimum epoch of 1924. After May 4th a long period of more or less spottedness consisting of some sporadic spots and other more permanent groups was noted until the close of the year. The month of December was so stormy and intensely cold that practically no observations were made.

1925

There was a decided revival of activity this year, especially during and following the month of May when numerous disturbed areas of the disc began to assert themselves, and groups of spots became more frequent in both the north and south hemispheres. In September still greater activity with bright aurorae was noted, and during the closing months fine large spots and streams were visible.

In the following tables are given the monthly summaries of the daily observations taken during the five year period.

Months	Number of Observing Days	Average Number of			Number of Spotless Days
		Groups	Spots	Faculae	
1921					
January	7	2.6	13.0	3.1	0
February	14	1.8	9.3	2.5	0
March	16	2.1	7.0	2.5	2
April	11	2.4	9.0	3.2	1
May	16	1.5	6.2	3.0	1
June	15	2.0	11.5	2.2	0
July	11	2.5	15.0	2.4	0
August	13	1.5	6.5	2.0	4
September	15	1.3	6.7	2.3	4
October	18	1.3	5.4	1.6	5
November	13	1.0	3.1	1.4	5
December	12	1.3	8.0	1.7	3
1922					
January	8	1.1	3.5	1.6	2
February	9	1.5	6.1	1.7	1
March	16	2.8	22.0	1.7	0
April	15	1.1	3.1	2.0	8
May	13	0.5	2.8	1.2	6
June	16	0.7	2.1	1.4	9
July	9	1.1	5.0	1.3	3
August	12	0.4	2.5	0.7	8
September	16	0.4	1.0	0.6	9
October	20	0.8	2.6	1.0	8
November	14	0.8	2.4	0.9	4
December	13	1.4	6.8	0.7	4
1923					
January	10	0.5	1.2	1.7	6
February	8	0.0	0.0	1.2	8
March	12	0.4	2.2	0.6	7
April	21	0.5	1.8	0.9	12
May	14	0.4	1.1	0.7	8
June	12	0.9	5.8	0.8	4
July	13	0.5	1.4	0.8	8
August	10	0.0	0.0	0.5	10
September	17	1.2	5.5	0.8	2
October	22	1.1	3.0	1.0	2
November	18	1.0	5.0	1.0	4
December	16	0.3	1.2	1.0	12
1924					
January	15	0.0	0.0	0.8	15
February	18	0.5	3.4	0.7	11
March	14	0.2	0.6	0.5	11
April	21	0.4	6.1	0.8	14
May	13	1.5	7.1	2.0	3
June	13	1.3	7.8	1.4	0
July	13	2.3	10.5	1.8	0
August	16	1.5	5.6	1.7	0
September	17	2.3	11.3	2.1	0
October	19	2.3	9.6	2.3	0
November	10	1.8	17.3	2.6	1
December	3	0.6	6.3	3.0	1

Months	Number of Observing Days	Average Number of			Number of Spotless Days
		Groups	Spots	Faculae	
1925					
January	14	0.9	3.8	2.0	5
February	8	1.7	6.1	3.0	1
March	15	1.1	7.8	2.1	2
April	14	3.0	10.8	2.5	0
May	13	2.8	16.7	2.2	0
June	10	4.5	22.9	3.4	0
July	2	3.0	14.5	3.0	0
August	6	2.3	11.7	2.8	1
September	6	4.3	26.3	3.8	0
October	7	4.6	26.0	4.7	0
November	11	3.2	20.1	3.9	0
December	9	6.2	40.6	4.2	0

AVERAGE NUMBER OF GROUPS FOR THE THIRTY-FIVE YEAR PERIOD

Year	Average Number of Groups	Year	Average Number of Groups
1891	2.9	1909	2.9
1892	5.6	1910	1.3
1893	6.6	1911	0.62
1894	5.6	1912	0.36
1895	5.2	1913	0.14
1896	3.2	1914	0.95
1897	2.2	1915	3.0
1898	2.1	1916	4.5
1899	1.1	1917	7.3
1900	0.7	1918	5.7
1901	0.25	1919	4.5
1902	0.37	1920	2.4
1903	1.65	1921	1.8
1904	3.1	1922	1.0
1905	4.0	1923	0.6
1906	3.8	1924	1.23
1907	3.8	1925	3.13
1908	3.4		

REVIEWING THE OBSERVATIONS OF THE THIRTY-FIVE YEARS THE FOLLOWING DATES HAVE BEEN DERIVED

Minimum of 1889.6 to the maximum of 1893.7.....	4.1 years
Maximum of 1893.7 to the minimum of 1901.5.....	7.8 years
Minimum of 1901.5 to the maximum of 1905.9.....	4.4 years
Maximum of 1905.9 to the minimum of 1913.5.....	7.6 years
Minimum of 1913.5 to the maximum of 1917.7.....	4.2 years
Maximum of 1917.7 to the minimum of 1924.1.....	6.4 years
Minimum of 1889.6 to the minimum of 1901.5.....	11.9 years
Minimum of 1901.5 to the minimum of 1913.5.....	12.0 years
Minimum of 1913.5 to the minimum of 1924.1.....	10.6 years
Maximum of 1893.7 to the maximum of 1905.9.....	12.2 years
Maximum of 1905.9 to the maximum of 1917.7.....	11.8 years